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CHECKLIST

Status, distribution and research gaps of rodents (Mammalia: Rodentia) in North-Eastern States of India

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Abstract

In North Eastern states of India (NE India) there are almost 65% of mammal species of the country but baseline information on small mammals, particularly rodents, for the region is scanty. Present study recorded a total of 59 species of rodents from the NE India out of 100 species reported from Indian Subcontinent. The list contains all the valid taxonomic names and their distribution in the states of NE India. Additionally, five species has been added to the checklist of rodents in India. The list provided 59 species belonging to 30 genera under 5 families of 7 subfamilies. Among them Muridae was recorded to be with highest number of species (31 species), followed by Sciuridae with 22 species, Cricetidae with three species, while Spalacidae and Hystricidae have recorded only two species in each group. Among the eight states of NE India the highest number of species was recorded from Arunachal Pradesh (76 %) and the lowest, from Tripura (22%). Two Threatened, three Near Threatened, two Not Listed and six Data Deficient species have been listed from the present work with four endemic species from this region. The findings of this study indicated the requirements for intensive and extensive surveys in the north-eastern States of India and taxonomic revisions of many species.

Keywords

Checklist, Flying Squirrel, North-Eastern States of India, Porcupine, Rat, Rodentia, Mammalia

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PENSOFT

Introduction

Past few decades have shown promising results in the discoveries of rodent species from the south-eastern Asia. Several new species of genus *Petaurista* Link, 1795 have been discovered or recorded from India (Choudhury 2007; 2009; 2013) while genus *Biswamoyopterus* Saha (1981) stands no longer endemic to India (Sanamxay et al. 2013; Li et al. 2019). *Sommeromys macrorhinos* Musser and Durden (2002) has been discovered as a new genus and a species from central Sulawesi. Auffray et al (2003) described a new species of subgenus *Mus* as *M. fragilicauda* from Thailand. Jenkins et al (2005) described a new family Laonastidae, genus *Laonastes* and a species *L. aenigmamus* from Lao People's Democratic Republic. Heany et al (2011) described seven new species from Philippines with a new description of a subgenus *Apomys* (*Megapomys*). Ge et al. (2020) reviewed the *Niviventer* species complex from the specimens studied at China through morphological and molecular approach and described *Niviventer fengi* as a novel species. Despite of these recent studies, rodents have been always neglected and less progressive than the other taxa (Lee and Liao 1998). Among all mammals, in spite of being the most diverse order, rodents are also less cared animals for conservation (Amori and Gippoliti 2003). Lesser advancement in the studies of rodent taxa may be due to its larger consideration as a pest species although evidence suggests that rodents are tool for promoting biodiversity (Reichman and Seabloom 2002). Majority of the rodent species has been marked as exploiters of human agricultural resources and several species are known to carry potential harmful diseases for humans (Singleton et al. 1999). Despite of being a harmful animal to humans, rodents are known to contribute several important aspects in balancing the natural world. Studies have shown that rodents are not only an important seed dispersal animal and serves as a prey base for most of the mammalian and avian carnivores in forests but also act as a supressing agent for alien invasive species (Eviner and Chapin 2003), contribute significantly in biogeochemical cycles, an indicator species for industrial pollution, forest health and fragmentations, and are also known to act as sensitive barometers for changing climate (Singleton et al. 1999).

Scientific studies of rodents in India can be dated back to pre-independent British colonial years (Agrawal 2000). One of the major taxonomic reviews and systematics on rodents of Indian subcontinent were conducted by Ellerman (1961). Compilation of such work fuelled years of scientific progress in the upcoming years. Following major revision of the rodent taxa focusing only on the family Muridae and Hystricidae was accomplished by Agrawal (2000). Since the works of Agrawal (2000) several changes have occurred in global taxonomy of rodents as subsequently the present paper will discuss later in details. New information on distributions and systematics based on molecular evidences has also provided several insights in the rodent taxonomy of world (Yu et al. 2006; Sanamxay et al. 2013; Ge et al. 2020). Last validation of rodent species was provided by Pradhan and Talmale (2011) listing a total of 103 species from India.

Covering about 8% of the total geographic area of the country, North Eastern states of India (NE India) is considered to be the highest in terms of mammalian diversity including 65% of the country's total mammal species (Choudhury 2013). However, only a handful and scattered reports on Rodents are so far available from the NE India. This region was selected as study site owing to its importance in terms of biodiversity because of its unique flora and fauna. North Eastern States of India harbours two biodiversity hotspots viz. Eastern Himalaya and Indo-Burma Hotspot (Chandra et al. 2018). Studies for assessing the presence of faunal species in the NE India have been conducted in the past and are compiled as State Fauna Series by the Zoological Survey of India (Das et al. 1995; Bhattacharya and Ghosh 2002; Chattopadhyay et al. 2006; De et al. 2006). Most of these studies are survey based or based on secondary information. Few articles are although based on some aspects of the rodents viz. rodents and the bamboo flowering (Bhattacharjee et al. 1979; Pathak and Kumar 2000; Chauhan 2003; Biswas et al. 2016), threatened rodent species of Arunachal Pradesh (Kumawat et al. 2013), diversity of gliding squirrels (Krishna et al. 2016). Ecology, population, demography and effect of human induced habitat fragmentation and encroachments are not known. Moreover, presence of several cryptic species assemblage viz. *Leopoldamys*, *Niviventer*, *Rattus* or *Mus* species complex and poor taxonomic studies on rodents with both morphological and molecular tools and inaccessibility at several locations may have slowed down the rodent research exploration in NE India. Current and regional conservation status for the rodents in these regions are in need of assessment. Considering the lack of substantial and basic information, a checklist of rodent species has been worked out to act as a base line information for the future studies in NE India.

Materials and Methods

Study Area

NE India comprises of eight states namely, Assam, Arunachal Pradesh, Mizoram, Manipur, Meghalaya, Nagaland, Tripura and Sikkim. These states cover three biogeographic zones viz. the Trans Himalaya, Himalaya and North East India representing 5 provinces namely Trans Himalaya Sikkim (1C), Central Himalaya (2C), East Himalaya (2D), Brahmaputra Valley (9A) and North East Hills (9B) (Rodgers and Panwar 1988) and holds distinguished 51 types of forest types under 13 broad categories viz. tropical wet evergreen forests, tropical semi-evergreen forests, tropical moist deciduous forests, littoral and swamp forests, tropical dry deciduous forests, subtropical broad-leaved hill forests, subtropical pine forests, montane wet temperate forests, Himalayan moist temperate forests, Himalayan dry temperate forests, sub-alpine forests, moist alpine scrub and dry alpine scrub (Champion and Seth 1968). NE India shares international borders with Bangladesh, Bhutan, China, Myanmar and Nepal which is almost about 2000 km^2. The area acts as a geographic

gateway for its distinctive flora and fauna due to its sub-tropical belt extending from the foothills of Himalaya in the west to east up to the south eastern China (Tripathi et al. 2016).

Methodology

The present checklist was compiled through examining the specimens present in the National Zoological Collection, Kolkata. Also, literatures from the archives of Zoological Survey of India, State fauna series, and published peer reviewed research articles and reports available online/offline was used to document the basic species checklist for the present study. Taxonomic positions and the validity of individual species as well as their present status was confirmed using Wilson and Reeder 2005; Pimsai et al. 2014; Ellerman 1961; Musser, 1973, 1981; Agrawal 2000. This compilation has taken into account all the species with current valid/updated names based on the present available online literatures. Map of the study area was prepared using ArcGIS 10.4 (ESRI 2016). Graphs were created using online data visualization website (Anonymous 2020).

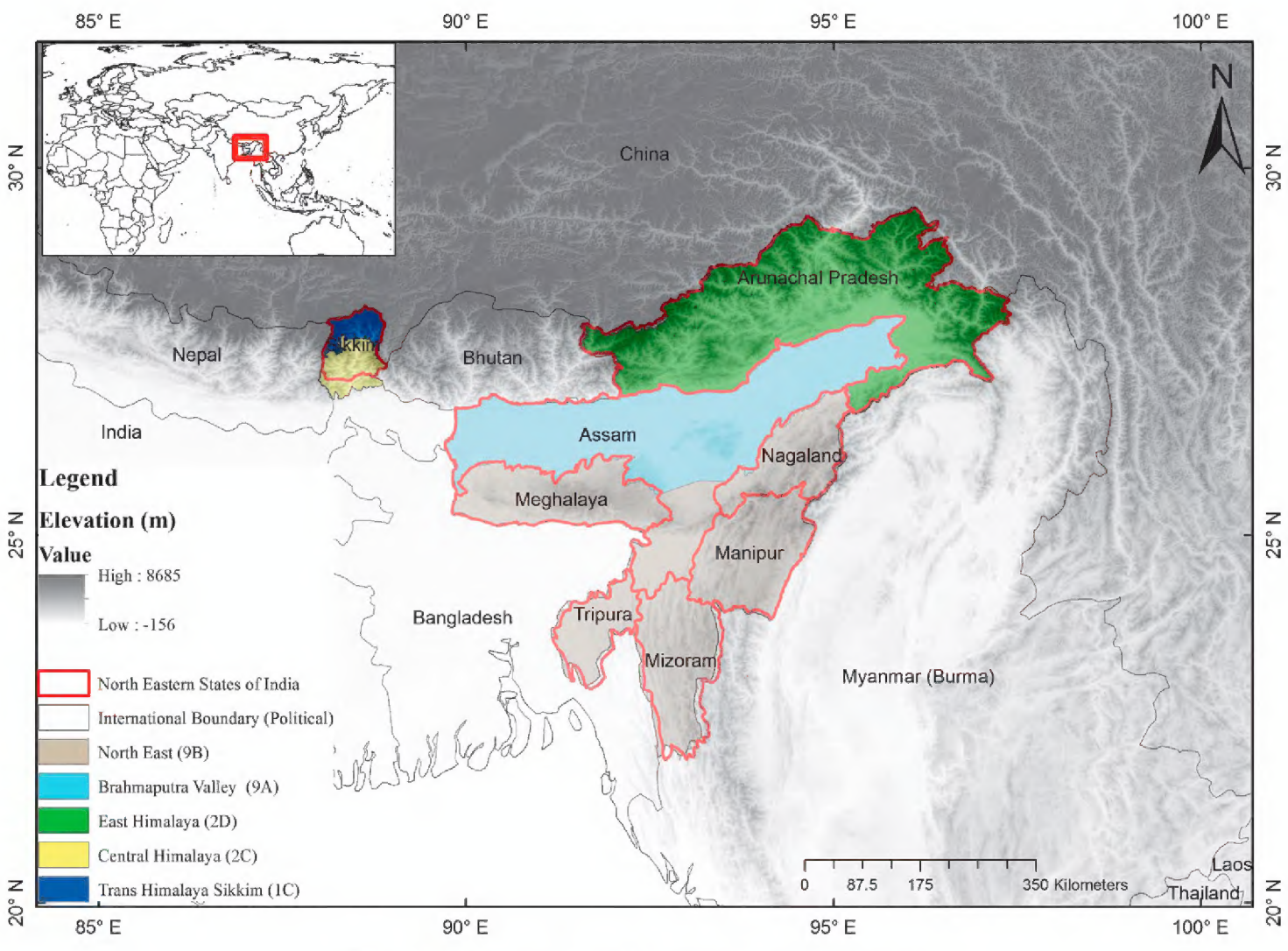

Figure 1. Map of North-Eastern states of India.

Results and Discussion

Current compilation resulted in 59 species of rodents under 30 genera from 5 families and 7 subfamilies from North-Eastern states of India as against to 100 species of rodents which belongs to 46 genera representing 7 families from India (Kamalakannan and Venkatraman 2017).

Family Muridae (rats and mice) has contributed with maximum number of species (31), followed by Sciuridae (squirrels) with 22 species, Cricetidae (mountain voles) with three species, Spalacidae (bamboo rats) and Hystricidae (porcupines) with two species in each group (Fig. 3). Arunachal Pradesh (76%) recorded the highest number of rodent species and Tripura (22%) recorded the lowest number of rodent species among the NE states of India.

There is a wide gap between the number of rodents reported from Arunachal Pradesh and the rest of the states in NE region (Fig. 2). Being within a global biodiversity hotspot (Velho 2013) and also much more number of focused explorations could be a possible reasons for the higher record of rodents from Arunachal Pradesh. Similarly, the low record of rodents in Tripura may be attributed to poor field surveys undertaken in the state. Out of the recorded 59 species, *Biswamoyopterus biswasi* Saha, 1981, is considered to be as Critically Endangered as per IUCN Redlist, *Hadromys humei* (Thomas, 1886) as Endangered, *Ratufa bicolor* (Sparrman, 1778), *Petaurista nobilis* (Gray, 1842) and *Petaurista mishmiensis* Choudhury, 2009 listed as Near Threatened, *Belomys pearsonii* (Gray, 1942), *Petaurista mechukaensis* Choudhury, 2007, *Berylmys mackenziei* (Thomas, 1916), *Berylmys manipulus* (Thomas, 1916), *Dacnomys millardi* Thomas, 1916 and *Diomys crumpi* Thomas,

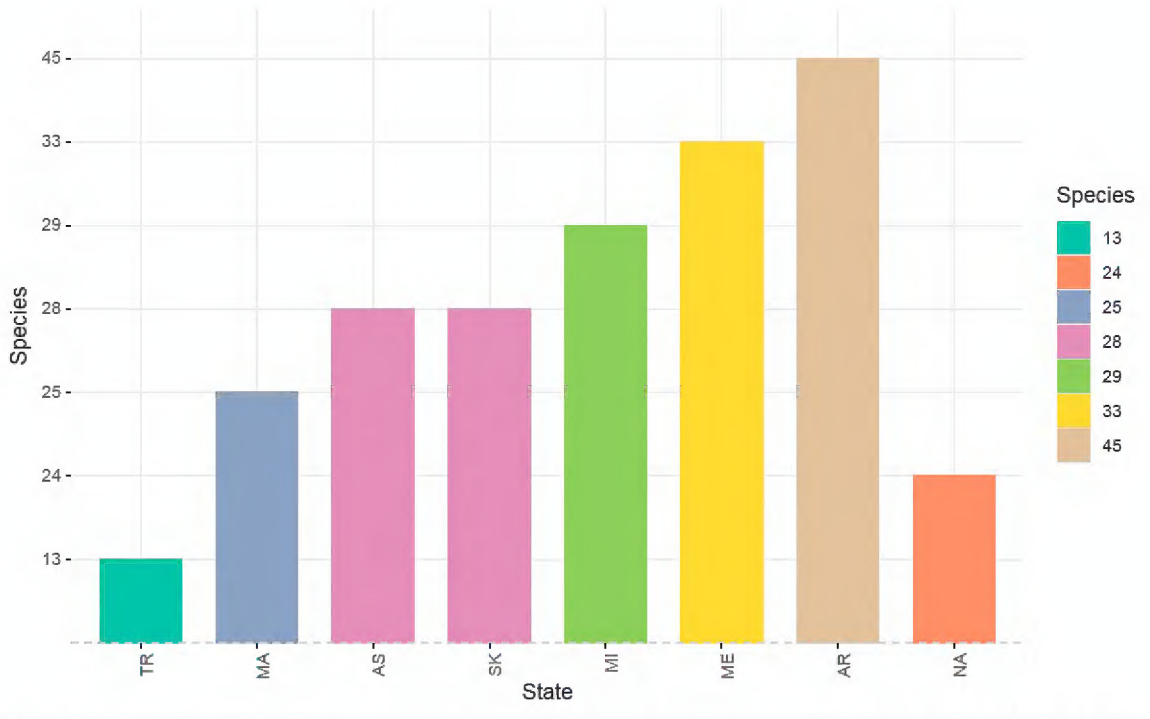

Figure 2. Graph representing number of rodent species recorded from different states of the North-eastern states of India. TR: Tripura, MA: Manipur, AS: Assam, SK: Sikkim, MI: Mizoram, ME: Meghalaya, AR: Arunachal Pradesh, NA: Nagaland.

1917 as Data Deficient and two species, *Petaurista yunanensis* (Anderson, 1875) and *Petaurista siangensis* Choudhury, 2013 has not been listed so far (Table 1). Also, the present checklist reports five species of Genus *Petaurista* which has not been mentioned in the checklist of Indian mammals or Indian rodents before (Kamalakannan and Venkatraman 2017; Kamalakannan et al. 2018) which may ensure the number of rodent species in India to be 105 species (Krishna et al. 2016). Rest of the recorded Rodent species are Least Concerned as per the IUCN Redlist (Table 1). Apart from their conservation status, four species viz. *P. mishmiensis* Choudhury, 2009; *P. mechukaensis* Choudhury, 2009; *P. siangensis* Choudhury, 2013 and *H. humei* (Thomas 1886) are known currently as endemic to India.

Current status and distribution of the Rodents in north-eastern states of India is in need of focused survey and reassessment as plenty of misleading information and gap areas exist. For instance, there has been a long debate between the validation of *Petaurista caniceps* and *P. elegans*. While Corbet and Hill (1992) considered these two species to be sympatric, Wilson and Reeder (2005) kept *P. caniceps* as subspecies of *P. elegans*. Molecular studies (Yu et al. 2006) have shown promising results separating these two species and validating their distinct speciation as well as it is found in the morphological characteristics. *P. caniceps* has been found to maintain a distinct lineage from *P. elegans* with a difference of more than 16% in the molecular analysis. Such a large genetic distinction should be considered as separate species. *P. caniceps* lack any white speckling on its back and has a grey forehead. These characters alone separates the species from the rest of the flying squirrels of genus *Petaurista* (Li et al. 2013). Still IUCN and Checklist of mammals in India (Sharma et al. 2014) have not considered *P. caniceps* as a valid species. Although the species *P. alborufus* has been reported from East Khasi hill, Meghalaya, India since 1995 based on museum specimen collected way back in 1847 and recently

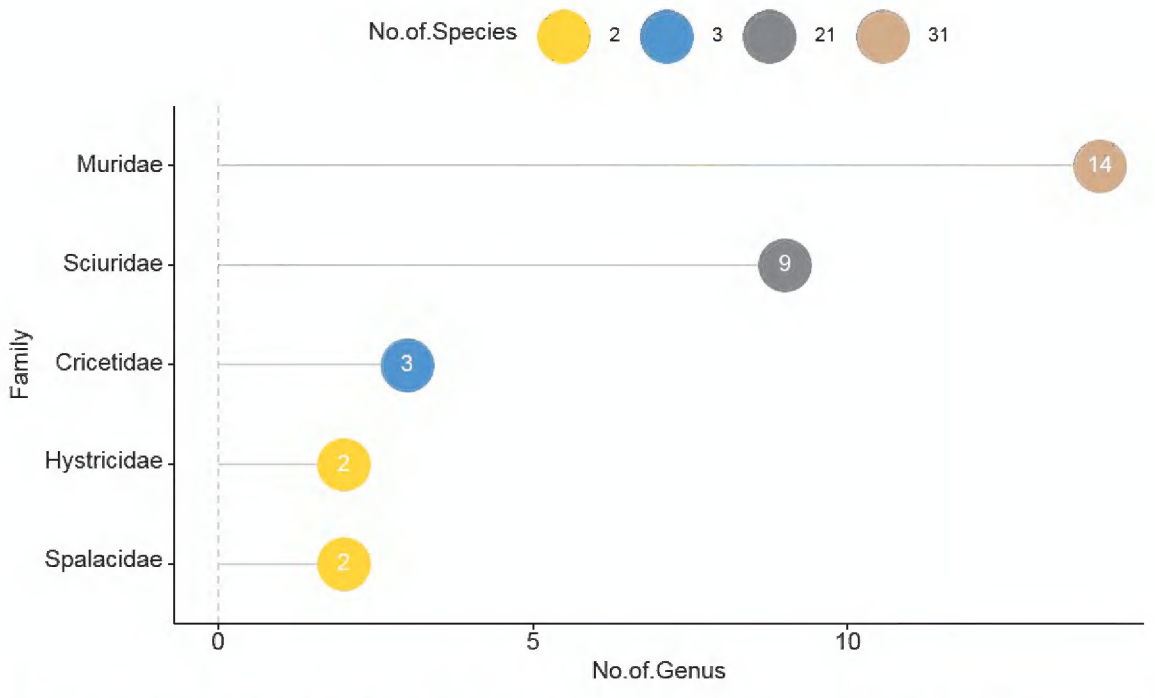

Figure 3. Graph representing diversity of rodent species among different families recorded in the North-Eastern states of India.

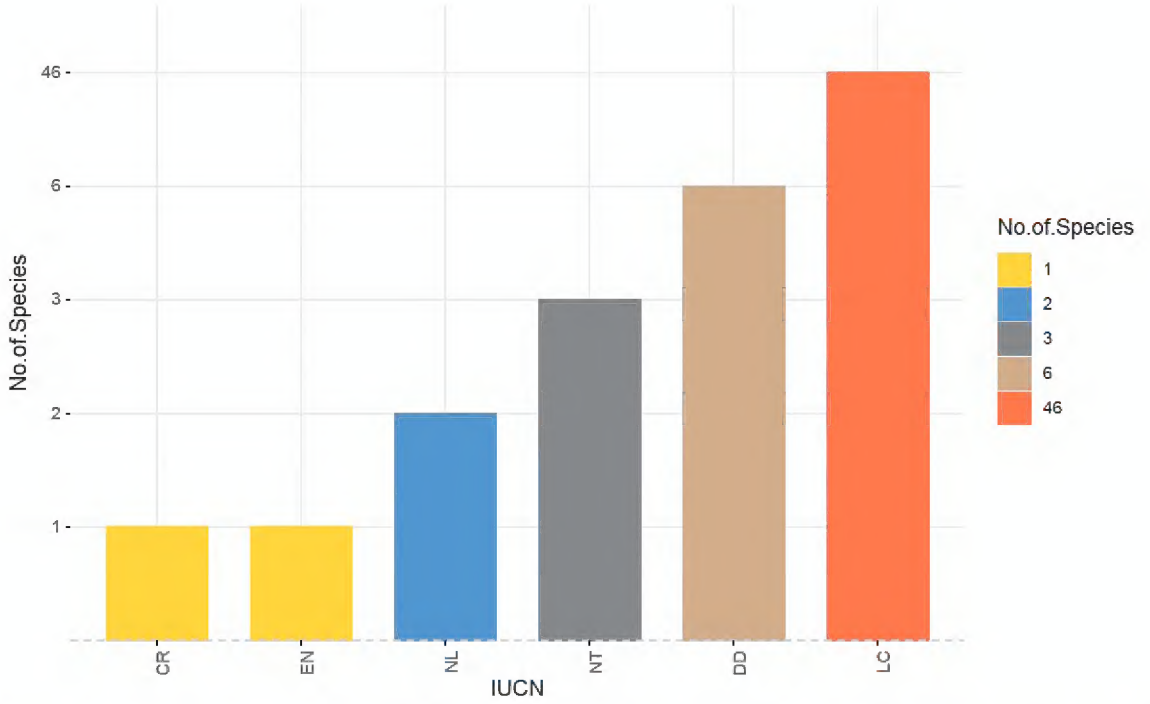

Figure 4. Graph representing conservation status of rodent species recorded in the states of North-East India as per the IUCN Redlist. CR: Critically Endangered, EN: Endangered, NL: Not Listed, NT: Near Threatened, DD: Data Deficient, LC: Least Concern.

again from Namdapha National Park, Arunachal Pradesh in 2016, IUCN still not considered the species range within India (Das et al. 1995; Krishna et al. 2016). The species has neither been reported by Wilson and Reeder (2005); Pradhan and Talmale (2011); Sharma et al. (2014) nor by Kamalakannan et al. (2018). Similarly, *Petaurista yunanensis* has been long due to be considered as a validated species. Morphological and molecular studies revealed the species to have a distinct lineage than the other species of the genus *Petaurista* (Oshida et al. 2010; Li et al. 2013; Wei et al. 2016). The Woolly Flying Squirrel or *Eupetaurus cinereus* Thomas, 1888 has been known to exist in the Western Himalayas especially in the state of Uttarakhand and in Gilgit Region of PoK, India and Northern Pakistan (Pal et al. 2018). A single skin of the species was reported by Agrawal and Chakraborty in 1970 from Sikkim without mentioning any proper location of collection after which no record of its existence has been found from Sikkim indicating the need for more intensive survey for such threatened species. The particolored flying squirrel or *Hylopetes alboniger* has been recorded from Assam in 2013 (Krishna et al. 2013) yet the IUCN distribution range map does not indicate Assam for this species. Das et al. (1995) surveyed Meghalaya and reported presence of *Funumbulus pennantii* from Jayantia and Khasi hills and Sharma et al. (2014) also listed the distribution of *F. pennantii* in the North-Eastern India. Further Kamalakannan et al. (2018) listed this species to be distributed in eastern Himalaya whereas its presence from the eastern Himalaya by direct or indirect sightings are absent. Shyam and Saikia (2015) reported the species *F. pennantii* in their study from Assam which may have been misidentified with that of *Tamiops macclellandii*. *Tamiops macclellandii* can be easily mistaken as a juvenile of *Funumbulus pennantii* as the former is much smaller in size. None of the authors

Figure 5. Comparative graph of rodent diversity among India and North-Eastern states of India.

have stated how the identifications were validated in their article without examining a collected specimen. Neither does they explain how a species (*Funumbulus pennantii*), which is well known to be restricted in its distribution up to the western side of Rajghat gap, has been located beyond this geographical barrier (Thorington and Cifelli 1990). Blyth's Mountain Vole or *Phaiomys leucurus* (Blyth 1863) is so far recorded only from the western Himalayas (Jammu and Kashmir, Himachal Pradesh) in India (Wilson and Reeder 2005; Sharma et al. 2014) whereas IUCN distribution map shows the species distribution in almost entire part of the eastern Sikkim. Kamalakannan et al. (2018) has also mentioned this species to be present in the eastern Himalayas. Another species *Mus booduga* has been enlisted in the species list of Kamalakannan et al. (2018) as distributed in eastern Himalayas, whereas the species has never been reported from any of the north eastern states so far (Agrawal 2000; Wilson and Reeder 2005; Aplin et al. 2016). The species *Leopoldamys sabanus* (Thomas 1887) is reported from the Changlang district of Arunachal Pradesh but is not confirmed whether it is *L. sabanus* or any other species. Its current status is therefore unconfirmed (Srinivasulu and Srinivasulu 2012). Under these circumstances it is highly recommended for intensive and extensive surveys for rodents in the North-eastern states of India and to put more focus on the taxonomic revisions of these species. Survey in the state of Tripura is also suggested, as it is the least recorded rodent species state in the north-eastern states. Apart from the taxonomic surveys, great deals of ecological knowledge of these rodent species calls for more studies required to be conducted on their population and habitat features.

While examining the data it was observed that the distribution of *Diomys crumpi* was restricted only to the state of Manipur in the present study. The Northern most population of this species has been recorded from Nepal and the southernmost population from Myanmar. There is a possibility the species might also be therefore

Table 1. Validated checklist of rodents from the north-eastern states of India. MI: Mizoram, TR: Tripura, MA: Manipur, AS: Assam, ME: Meghalaya, AR: Arunachal Pradesh, NA: Nagaland, SK: Sikkim, CR: Critically Endangered; DD: Data Deficient; EN: Endangered, NT: Near Threatened, LC: Least Concern, NL: Not Listed. NZSI: National Zoological Collection of the Zoological Survey of India.

Sl. No.	Name of the Species	State (NE) where present	Conservation Status(IUCN)	Reference
	Order RODENTIA			
	SUBORDER SCIUROMORPHA			
	Family Sciuridae **Subfamily Ratufinae**			
1.	*Ratufa bicolor* (Sparrman, 1778) Black Giant Squirrel	AR, AS, ME, MI, NA, SK, TR.	NT	NZSI, Duckworth and Molur 2016
	Subfamily Sciurinae			
2.	*Belomys pearsonii* (Gray, 1942) Hairy-footed Flying Squirrel	MI, MA, ME, AR, NA, SK	DD	NZSI; Wilson and Reeder 2005
3.	*Biswamoyopterus biswasi* Saha, 1981 Namdapha Flying Squirrel	AR	CR	NZSI
4.	*Hylopetes alboniger* (Hodgson, 1836) Particoloured Flying Squirrel	MI, ME, AR, SK	LC	Wilson and Reeder 2005; Krishna et al. 2013
5.	*Petaurista elegans* Muller, 1840 Spotted Giant Flying Squirrel	AR, SK	LC	NZSI; Krishna and Kumar 2017
6.	*Petaurista caniceps* (Gray, 1842)	AR, SK	LC	Krishna and Kumar 2017
7.	*Petaurista magnificus* (Hodgson, 1836) Hodgson's Giant Flying Squirrel	ME, AR, SK	LC	NZSI; Wilson and Reeder 2005
8.	*Petaurista nobilis* (Gray, 1842) Bhutan Giant Flying Squirrel	AR, SK	NT	NZSI
9.	*Petaurista petaurista* (Pallas, 1766) Red Giant Flying Squirrel	MI, AR	LC	NZSI; Wilson and Reeder 2005
10.	*Petaurista philippensis* (Elliot, 1839) Indian Giant Flying Squirrel	MI, AS, AR	LC	NZSI
11.	*Petaurista alborufus* (Milne-Edwards, 1870) Red And White Giant Flying Squirrel	ME, AR	LC	Das et al. 2005; Krishna et al. 2016
12.	*Petaurista mishmiensis* Choudhury, 2009 Mishmi Giant Flying Squirrel	AR	NT	Choudhury 2009
13.	*Petaurista mechukaensis* Choudhury, 2007 Mechuka Giant Flying Squirrel	AR	DD	Choudhury 2009
14.	*Petaurista siangensis* Choudhury, 2013 Mebo Giant Gliding Squirrel	AR	NL	Choudhury 2013
15.	*Petaurista yunanensis* (Anderson, 1875) Yunnan Giant Gliding Squirrel	AR	NL	Krishna et al. 2016
	Subfamily Callosciurinae			
16.	*Callosciurus erythraeus* (Pallas, 1779) Palla's Squirrel	MI, TR, MA, AS, ME, AR, NA	LC	NZSI; Wilson and Reeder 2005
17.	*Callosciurus pygerythrus* (I. Geoffroy Saint Hilaire, 1832) Hoary-bellied Squirrel	MI, TR, MA, AS, ME, AR, NA, SK	LC	NZSI; Wilson and Reeder 2005
18.	*Dremomys lokriah* (Hodgson, 1836) Orange -bellied Himalayan Squirrel	MI, TR, MA, AS, ME, AR, NA, SK	LC	NZSI; Wilson and Reeder 2005

Table 1. (continued)

Sl. No.	Name of the Species	State (NE) where present	Conservation Status(IUCN)	Reference
19.	*Dremomys pernyi* (Milne-Edwards, 1867) Perny's Long -nosed Squirrel	MA, NA	LC	Lunde and Molur 2016a
20.	*Dremomys rufigenis* (Blanford, 1878) Red-Cheeked Squirrel	AS, AR, NA	LC	Pradhan and Talmale 2009; Choudhury 2013
21.	*Tamiops macclellandii* (Horsfield, 1840) Himalayan Striped Squirrel	MI, ME, AR, SK, MA	LC	Pradhan and Talmale 2009
	Sub family Xerinae			
22.	*Marmota himalayana* (Hodgson, 1841) Himalayan Mormot	AR, SK	LC	Shrestha 2016
	SUB ORDER MYOMORPHA			
	Family Spalacidae **Subfamily Rhizomyinae**			
23.	*Cannomys badius* (Hodgson, 1841) Lesser Bamboo Rat	MI, MA, AS, ME, NA	LC	Wilson and Reeder 2005; Aplin et al. 2016
24.	*Rhizomys pruinosus* Blyth, 1851 Hoary Bamboo Rat	MA, ME, NA	LC	Agrawal 2000; Aplin and Molur 2016
	Family Cricetidae **Subfamily Arvicolinae**			
25.	*Alticola stoliczkanus* (Blanford, 1875) Stoliczka's Mountain Vole	SK	LC	Srinivasulu and Srinivasulu 2012
26.	*Neodon sikimensis* (Horsfield, 1841) Sikkim Vole	SK	LC	Wilson and Reeder 2005
	Family Muridae **Subfamily Murinae**			
27.	*Apodemus draco* (Barret-Hamilton, 1900) South China Field Mouse	AR	LC	Wilson and Reeder 2005
28.	*Apodemus latronum* Thomas, 1911 Large-eared Field Mouse	AR	LC	Sarkar et al. 2005
29.	*Bandicota bengalensis* (Gray, 1835) Lesser Bandicoot Rat	MI, TR, MA, AS, ME, AR, NA	LC	Agrawal 2000
30.	*Bandicota indica* (Bechstein, 1800) Greater Bandicoot Rat	MI, TR, AS, ME, SK	LC	Agrawal 2000
31.	*Berylmys bowersi* (Anderson, 1879) Bower's White-toothed Rat	MI, MA, AS, ME, AR, NA	LC	Agrawal 2000; Wilson and Reeder 2005
32.	*Berylmys mackenziei* (Thomas, 1916) Kenneth's White-toothed Rat	MI, MA, AS, ME, NA	DD	Agrawal 2000; Wilson and Reeder 2005
33.	*Berylmys manipulus* (Thomas, 1916) Manipur White-toothed Rat	MA, AS, NA	DD	Agrawal 2000; Wilson and Reeder 2005
34.	*Chiropodomys gliroides* (Blyth, 1856) Indomalayan Pencil-tailed Tree Mouse	MI, TR, AS, ME, AR	LC	Agrawal 2000
35.	*Dacnomys millardi* Thomas, 1916 Millard's Rat	AR, NA	DD	Agrawal 2000
36.	*Diomys crumpi* Thomas, 1917 Crump's Mouse	MA	DD	Agrawal 2000
37.	*Golunda ellioti* Gray, 1837 Indian Bush-rat	AS	LC	Agrawal 2000; Wilson and Reeder 2005

Table 1. (continued)

Sl. No.	Name of the Species	State (NE) where present	Conservation Status(IUCN)	Reference
38.	*Hadromys humei* (Thomas, 1886) Hume's Rat	MA, AS	EN	Agrawal 2000; Wilson and Reeder 2005
39.	*Leopoldamys edwardsi* (Thomas, 1882) Edward's Rat	ME, AR, NA	LC	Agrawal 2000; Wilson and Reeder 2005
40.	*Leopoldamys sabanus* (Thomas, 1887) Long-tailed Giant Rat	AR	LC	Aplin et al. 2016
41.	*Micromys minutus* (Pallas, 1771) Eurasian Harvest Mouse	ME, NA	LC	Agrawal 2000; Wilson and Reeder 2005
42.	*Mus cervicolor* Hodgson, 1845 Fawn-coloured Mouse	MA, ME, SK	LC	Agrawal 2000; Wilson and Reeder 2005
43.	*Mus cookii* Ryley, 1914 Reyley's Spiny Mouse	MI, MA, AS, ME, AR, NA	LC	Agrawal 2000; Wilson and Reeder 2005
44.	*Mus musculus* Linnaaeus, 1758 House Mouse	MI, TR, MA, AS, ME, AR, NA, SK	LC	Agrawal 2000; Wilson and Reeder 2005
45.	*Mus pahari* Thomas, 1916 Gairdner's Shrewmouse	MI, ME, AR, SK, AS, NA	LC	Agrawal 2000; Wilson and Reeder 2005
46.	*Niviventer brahma* (Thomas, 1914) Brahma White-bellied Rat	AR	LC	Wilson and Reeder 2005
47.	*Niviventer eha* (Wroughton, 1916) Smoke-bellied Rat	SK	LC	Agrawal 2000; Wilson and Reeder 2005
48.	*Niviventer fulvescens* (Gray, 1847) Chestnut White-bellied Rat	MA, AS, ME, AR, SK	LC	Agrawal 2000; Wilson and Reeder 2005
49.	*Niviventer langbianis* (Robinson & Kloss, 1922) Dark-tailed Rat	AR, AS	LC	Agrawal 2000; Wilson and Reeder 2005
50.	*Niviventer niviventer* (Hodgson, 1836) Himalayan White-bellied Rat	MI, MA, AR, ME, AR, NA, SK	LC	Agrawal 2000; Wilson and Reeder 2005
51.	*Rattus andamanensis* (Blyth, 1860) Indochinese Forest Rat	MA, ME, AR, NA, SK	LC	Wilson and Reeder 2005; Aplin et al. 2016
52.	*Rattus nitidus* (Hodgson, 1845) Himalayan Field Rat	MI, TR, MA, ME, AR, SK	LC	Agrawal 2000; Wilson and Reeder 2005
53.	*Rattus pyctoris* (Hodgson, 1845) Himalayan Rat	AR, SK	LC	Agrawal 2000; Wilson and Reeder 2005
54.	*Rattus rattus* (Linnaeus, 1758) House Rat	MI, TR, MA, AS, ME, AR, NA, SK	LC	Agrawal 2000; Wilson and Reeder 2005
55.	*Rattus norvegicus* (Berkenhout, 1769) Brown Rat	MI, TR, AS, ME	LC	Agrawal 2000
56.	*Rattus tanezumi* Temminck, 1844 Oriental House Rat	SK, MI, TR, MA, AS, ME, AR, NA	LC	Heaney and Molur 2016
57.	*Vandeleuria oleracea* (Bennett, 1832) Asiatic long-tailed Climbing Mouse	MI, MA, AS, ME, NA, TR, SK	LC	Aplin and Molur 2017
	SUBORDER HYSTRICOMORPHA			
	Family Hystricidae			
58.	*Atherurus macrourus* (Linnaeus,1758) Asiatic Bush-tailed Porcupine	MI, AS, ME, AR	LC	Agrawal 2000; Wilson and Reeder 2005; Molur 2016
59.	*Hystrix brachyura* Linnaeus, 1758 Malayan Porcupine	MI, MA, ME, AR, NA, SK	LC	Wilson and Reeder 2005; Lunde et al. 2016b

distributed in other states of the study area. *Golunda ellioti* Gray 1837 is reported only from Assam in the present study, whereas it is reported to be present throughout the country and also in Nepal (Kamalakannan and Venkatraman 2017). Possibility of this species being distributed in the other states of North East India is also possible. *A. stoliczkanus, N. sikkimensis* and *N. eha* which are typically high altitude species, have been found to be restricted only to Sikkim. These species may also be distributed in the higher altitudes of Arunachal Pradesh. Distribution of *B. biswasi, N. brahma, L. sabamus, A. draco, A. latronum* and 5 species of *Petaurista* have been recorded only from Arunachal Pradesh (Table 1). *M. himalayana, P. elegans, P.caniceps, P.nobilis* and *R. pyctoris* are found only in Arunachal Pradesh and Sikkim within the North-eastern states of India (Table 1). Furthermore, status of the critically endangered species of *B. biswasi* Saha 1981, and also *P. mechukaensis* Choudhury 2007, *P. siangensis* Choudhury 2013, *P. mishmiensis* Choudhury 2009, and *P. yunanensis* (Anderson 1875) reported only from the state of Arunachal Pradesh, is recommended to be assessed as no report from the region after its discovery has been noted recently.

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References

Agrawal VC (2000) Taxonomic Studies on Indian Muridae and Hystricidae (Mammalia Rodentia). Records of Zoological Survey of India (Published: Director, Zoological Survey of India, Calcutta), Occasional Paper No. 180. i–viii. 1–186.

Agrawal VC, Chakraborty S (1970) Occurrence of the woolly flying squirrel, *Eupetaurus cinereus* Thomas (Mammalia: Rodentia: Sciuridae) in North Sikkim. Journal of the Bombay Natural History Society 66: 615–616.

Amori G, Gippoliti S (2003) A higher-taxon approach to rodent conservation priorities for the 21st century. Animal Biodiversity and Conservation 26(2): 1–18. https://www.raco.cat/index.php/abc/article/view/57406.

Anonymous (2020) Data Visualization using R. https://tinyurl.com/Many-Bars.

Aplin K, Frost A, Chakraborty S, Molur S, Nameer, PO (2016) *Rattus andamanensis* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T19361A115149094. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T19361A22446146.en. Downloaded on 18 March 2019.

Aplin K, Lunde D, Musser G, Frost A, Molur S (2016) *Cannomys badius* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T3759A115066803. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T3759A22274794.en. Downloaded on 18 March 2019.

Aplin K, Molur S (2016) *Rhizomys pruinosus* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T19645A115152385. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T19645A22274964.en. Downloaded on 18 March 2019.

Aplin K, Molur S (2017) *Vandeleuria oleracea*. The IUCN Red List of Threatened Species 2017: e.T22845A22430846. http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T22845A22430846.en. Downloaded on 18 March 2019.

Aplin K, Molur S, Nameer, PO (2016) *Mus booduga* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T13953A115115984. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T13953A22403517.en. Downloaded on 18 March 2019.

Aplin K, Rueda L, Molur S (2016) *Leopoldamys sabanus*. The IUCN Red List of Threatened Species 2016: e.T11520A22434377. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T11520A22434377.en. Downloaded on 18 March 2019.

Auffray JC, Orth A, Catalan J, Gonzalez JP, Desmarais E, Bonhomme F (2003) Phylogenetic position and description of a new species of subgenus *Mus* (Rodentia, Mammalia) from Thailand. Zoologica Scripta 32(2): 119–127.

Bhattacharjee S, Bhattacharjee A, Sone L (1979) Incidence of rodent pests during bamboo flowering in Arunachal Pradesh. Rodents Newsletter 23(1–2): 2.

Bhattacharya TP, Ghosh MK (2002) Mammals. In: Fauna of Tripura, State Fauna Series. Published by the Director, Zoological Survey of India, Kolkata 7 (Part-1): 31–46.

Biswas S, Kumar S, Mittal V (2016) A Note on Rodent Migration following Gregarious Bamboo Flowering in North-Eastern Hill Region with Particular Reference to Mizoram (India) and Its Consequences. Journal of Communicable Diseases 48(3).

Champion HG, Seth SK (1968) A revised classification of the Forest Types in India. Manager Publication, Government of India, Delhi.

Chandra K, Gupta D, Gopi KC, Tripathy B, Kumar V (2018) Faunal Diversity of Indian Himalaya. Published by the Director, Zoological Survey of India, Kolkata. 872.

Chattopadhyay SS, Saha SS, Ghosh MK, Agrawal VC (2006) Mammals. In: Fauna of Sikkim, State Fauna Series, Published by the Director, Zoological Survey of India, Kolkata 9 (Part-1): 33–76.

Chauhan NPS (2003) Observations of bamboo flowering and associated increases in rodent populations in the north-eastern region of India. ACIAR Monograph Series 96: 267–270.

Choudhury A (2007) A new flying squirrel of the genus *Petaurista* Link from Arunachal Pradesh in north-east India. Newsletter and Journal of the Rhino Foundation for Nature in NE India 7: 26–32.

Choudhury A (2009) One more new species of Giant Flying Squirrel of the Genus *Petaurista* Link, 1795 from Arunachal Pradesh in north-east India. Newsletter and Journal of the Rhino Foundation for nature in NE India 8: 26–34.

Choudhury AU (2013) Descriptions of a new species of giant flying squirrel of genus *Petaurista* Link, 1795 from Siang basin, Arunachal Pradesh in North East India. News Letter & Journal of the Rhino Foundation for Nature in North East India 9: 30–38.

Corbet GB, Hill JE (1992) The mammals of the Indomalayan region: a systematic review. Oxford: Oxford University Press, London.

Das PK, Ghosh RK, Chakraborty TK, Bhattacharya TP, Ghosh MK (1995) Mammals. In: Fauna of Meghalaya, State Fauna Series, Published by the Director, Zoological Survey of India, Kolkata 4(1): 23–128.

De JK, Mandal AK, Ghosh MK (2006) Mammals. In: Fauna of Arunachal Pradesh, State Fauna Series, Published by the Director, Zoological Survey of India, Kolkata 13(l): 21–68.

Duckworth JW, Molur S (2016) *Ratufa bicolor*. The IUCN Red List of Threatened Species 2016: e.T19377A22261810. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T19377A22261810.en. Downloaded on 18 March 2019.

Ellerman JR, Roonwal ML, Biswas B, Blanford WT (1961) The fauna of India, including Pakistan, Burma and Ceylon: Mammalia. Rodentia. Zoological Survey of India.

ESRI E (2016) ArcGIS Desktop 10.4. Environmental Systems Research Institute: Redlands, CA, USA.

Eviner VT, Chapin III FS (2003) Functional matrix: a conceptual framework for predicting multiple plant effects on ecosystem processes. Annual Review of Ecology, Evolution, and Systematics 34(1): 455–485. https://doi.org/10.1146/annurev.ecolsys.34.011802.132342.

Ge D, Feijó A, Abramov AV, Wen Z, Liu Z, Cheng J, Xia L, Lu L, Yang Q (2020) Molecular phylogeny and morphological diversity of the Niviventer fulvescens species complex with emphasis on species from China. Zoological Journal of the Linnean Society. https://doi.org/10.1093/zoolinnean/zlaa040.

Heaney L, Molur S (2016) *Rattus tanezumi* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T19366A115149780. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T19366A22445589.en. Downloaded on 18 March 2019.

Heaney LR, Balete DS, Rickart EA, Alviola PA, Duya MRM, Duya MV, Veluz MJ, VandeVrede L, Steppan SJ (2011) Seven new species and a new subgenus of forest mice (Rodentia: Muridae: *Apomys*) from Luzon Island. Fieldiana Life and Earth Sciences. 2011 (2):1–60. https://doi.org/10.3158/2158-5520-2.1.1

Jenkins PD, Kilpatrick CW, Robinson MF, Timmins RJ (2005) Morphological and molecular investigations of a new family, genus and species of rodent (Mammalia: Rodentia: Hystricognatha) from Lao PDR. Systematics and Biodiversity 2(4): 419–454.

Kamalakannan M, Venkatraman C (2017) A Checklist of Mammals of India. Updated till October 2017, available at http://zsi.gov.in (online only).

Kamalakannan M, Venkatraman C, Sharma LK (2018) Diversity and Distribution of Mammals in the Indian Himalayas. In Indian Hotspots. Springer, Singapore. 177–204. https://doi.org/10.1007/978-981-10-6983-3_10.

Krishna CM, Ray PC, Sarma K, Kumar A (2013) Observations on Particolored flying squirrel *Hylopetes alboniger* (Hodgson 1836) in northeast India. Zoo's Print 28: 18–20.

Krishna MC, Kumar A (2017) Occurrence of Grey-headed Gliding Squirrel (*Petaurista caniceps*) in Arunachal Pradesh, India with a Note on Its Taxonomy. In Proceedings of the Zoological Society, Springer India 70(1): 97–99. https://doi.org/10.1007/s12595-015-0158-3.

Krishna MC, Kumar A, Tripathi OP, Koprowski JL (2016) Diversity, Distribution and Status of Gliding Squirrels in Protected and Non-protected Areas of Eastern Himalayas in India. Hystrix, the Italian Journal of Mammalogy 27(2). https://doi.org/10.4404/hystrix-27.2-11688.

Kumawat MM, Singh KM, Sen D, Tripathi RS (2013) Threatened rodent species of Arunachal Pradesh. International Journal of Agriculture, Environment and Biotechnology 6(4): 657. https://doi.org/10.5958/j.2230-732x.6.4.046.

Lee PF, Liao CY (1998) Species richness patterns and research trend of flying squirrel. Journal of Taiwan Museum 51(2): 1–20.

Li G-G, Lwin YH, Yang B, Qin T, Quan RC, Li S (2019) Taxonomic revision and phylogenetic position of the flying squirrel genus *Biswamoyopterus* (Mammalia, Rodentia, Sciuridae, Pteromyini) on the northern Indo-China peninsula. ZooKeys 872: 77–93. https://doi.org/10.3897/zookeys.872.31764.

Li S, He K, Yu FH, Yang QS (2013) Molecular phylogeny and biogeography of *Petaurista* inferred from the cytochrome b gene, with implications for the taxonomic status of *P. caniceps*, *P. marica* and *P. sybilla*. PloS one 8 (7): e70461. https://doi.org/10.1371/journal.pone.0070461.

Lunde D, Aplin K, Molur S (2016b) *Hystrix brachyura* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T10749A115099298. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T10749A22232129.en. Downloaded on 18 March 2019.

Lunde D, Molur S (2016a) *Dremomys pernyi* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T6822A115084426. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T6822A22255797.en. Downloaded on 18 March 2019.

Molur S (2016) *Atherurus macrourus*. The IUCN Red List of Threatened Species 2016: e.T2354A22231214. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2354A22231214.en. Downloaded on 18 March 2019.

Musser GG (1973) Species-limits of *Rattus cremoriventer* and *Rattus langbianis*, murid rodents of Southeast Asia and the Greater Sunda Islands. American Museum of Natural History.

Musser GG (1981) Notes on systematics of Indo-Malayan murid rodents, and descriptions of new genera and species from Ceylon, Sulawesi, and the Philippines. Bulletin of the AMNH 168(3).

Musser GG, Durden LA (2002) Sulawesi rodents: description of a new genus and species of Murinae (Muridae, Rodentia) and its parasitic new species of sucking louse (Insecta, Anoplura). American Museum Novitates. 2002(3368): 1–50. https://doi.org/10.1206/0003-0082(2002)368%3C0001:SRDOAN%3E2.0.CO;2

Oshida T, Dang CN, Nguyen ST, Nguyen NX, Endo H, Kimura J, Sasaki M, Hayashida A, Takano A, Hayashi Y (2010) Phylogenetics of *Petaurista* in light of specimens collected from northern Vietnam. Mammal study 35(1): 85–92. https://doi.org/10.3106/041.035.0107.

Pal R, Thakur S, Bhattacharya T, Sathyakumar S (2018) Range extension and high elevation record for the endangered woolly flying squirrel *Eupetaurus cinereus* in Western Himalaya, India. Mammalia 83(4): 410–414. https://doi.org/10.1515/mammalia-2018-0097.

Pathak KA, Kumar DK (2000) Bamboo flowering and rodent out-break in North Eastern hill region of India. Indian Journal of Hill Farming 13(1/2): 1–7.

Pimsai U, Pearch MJ, Satasook C, Bumrungsri S, Bates PJ (2014) Murine rodents (Rodentia: Murinae) of the Myanmar-Thai-Malaysian peninsula and Singapore: taxonomy, distribution, ecology, conservation status, and illustrated identification keys. Bonn Zoological Bulletin. 63: 15–114.

Pradhan MS, Talmale SS (2011) A Checklist of valid Indian Rodent Taxa (Mammalia: Rodentia). Published by Zoological Survey of India. http://zsi.gov.in/WriteReadData/userfiles/file/Checklist/54.pdf.

Reichman OJ, Seabloom EW (2002) The role of pocket gophers as subterranean ecosystem engineers. Trends in Ecology & Evolution 17(1): 44–49. https://doi.org/10.1016/s0169-5347(01)02329-1.

Rodgers WA, Panwar HS (1988) Planning a wildlife protected area network in India. Wildlife Institute of India, Dehra Dun.

Sanamxay D, Douangboubpha B, Bumrungsri S, Xayavong S, Xayaphet V, Satasook C, Bates PJ (2013) Rediscovery of *Biswamoyopterus* (Mammalia: Rodentia: Sciuridae: Pteromyini) in Asia, with the description of a new species from Lao PDR. Zootaxa 3686 (4): 471–481. https://doi.org/10.11646/zootaxa.3686.4.5.

Sharma G, Kamalakannan M, Venkataraman K (2014) A checklist of mammals of India with their distribution and conservation status. ZSI e-publications, Kolkata: Zoological Survey of India. http://zsi.gov.in/WriteReadData/userfiles/file/Checklist/Checklist%20of%20Mammals%20of%20India-Gaurav%20Sharma,%20M_%20Kamalakannan%20and%20K_%20Venkataraman-01-07-2015.pdf.

Shrestha T (2016) *Marmota himalayana* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T12826A115106426. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T12826A22258911.en. Downloaded on 18 March 2019.

Shyam C, Saikia PK (2015) Diversity and distribution of squirrel species in different forest fragments of Hollongapar Gibbon wildlife sanctuary, Jorhat, Assam, India. International Journal of Science and Research 6 (8): 1445–1452.

Singleton GR, Hinds LA, Leirs H, Zhang Z (1999) Ecologically-based rodent management, Canberra. ACIAR. 194.

Srinivasulu C, Srinivasulu B (2012) South Asian mammals: their diversity, distribution, and status. Springer Science & Business Media. http://dx.doi.org/10.1007/978-1-4614-3449-8.

Thorington RW Jr, Cifelli RL (1990) The unusual significance of the giant squirrels (*Ratufa*). Conservation in developing countries: problems and prospects. In: Daniel JC, Serrao JS (Eds). Proceedings of the Centenary Seminar of the Bombay Natural History Society. Bombay: Bombay Natural History Society/Oxford University Press. 656.

Tripathi SK, Roy A, Kushwaha D, Lalnunmawia F, Lalnundanga (2016) Perspectives of forest biodiversity conservation in northeast India. Journal of Biodiversity, Bioprospecting and Development 3(2): 1–9. http://dx.doi.org/10.4172/2376-0214.1000157.

Velho N, Laurance WF (2013) Hunting practices of an Indo-Tibetan Buddhist tribe in Arunachal Pradesh, north-east India. Oryx 47(3): 389-392. https://doi.org/10.1017/S0030605313000252

Wei W, Zhou W, Chen Q, Yang Y, Krzton A, Hu J, Li D (2016) Phylogenetic studies of *Petaurista petauri* based on complete mitochondrial DNA sequences. Mitochondrial DNA Part B 1(1): 708–709. https://doi.org/10.1080/23802359.2016.1225527.

Wilson DE, Reeder DM (2005) *Mammal species of the world*: a taxonomic and geographic reference. JHU Press. Vol. 1, 2142.

Yu F, Yu F, Pang J, Kilpatrick CW, McGuire PM, Wang Y, Lu S, Woods CA (2006) Phylogeny and biogeography of the *Petaurista philippensis* complex (Rodentia: Sciuridae), inter- and intraspecific relationships inferred from molecular and morphometric analysis. Molecular Phylogenetics and Evolution 38(3): 755–766. https://doi.org/10.1016/j.ympev.2005.12.002.